Space Weather Technical Forecast

Issued on Thursday 26 September 2024 at 13:18 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-flares (R1-R2 Blackouts). Increasing chance of Active High energy electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with one M1.3 flare observed at 26/2312 UTC from AR3828 on the southwest disc. There are eleven sunspot regions visible, however these are all relatively small and simple regions with only limited development. The largest is AR3836 in the southeast, however the most notable growth is associated with a new very small region in the northeast. Two further new regions are visible on the east limb, while two on while two regionsm AR3833 and AR3831, in the northwest are becoming harder to observe.

There were no Earth-directed CMEs , however there are a number of filaments on the Earth-facing disc, which have the potential to disrupt and produce CMEs.

Solar Wind / Geomagnetic Activity: Fast wind from CH72/+ continued to ease, with solar wind speeds at ACE and DSCOVR easing from elevated at 500-550km/s to be slightly elevated at just over 400 km/s. Density eased from slightly above average to below average. Interplanetary Magnetic Field, Bt, was Moderate, 8-10nT, at first but soon eased to be Weak 25/1400 UTC, becoming 4-8nT. The north-south component, Bz, was Moderate southward at first, at -9nT, but eased to be mainly weakly negative with minimum -5nT. Only brief periods of weakly positive (northward) field occurred, peaking +7nT. Phi angle was mostly positive (away from the Sun). Geomagnetic activity was Unsettled to Active (Kp 3-4) until 26/0600 UTC, then Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 was at Background. High energy electron flux (greater than 2MeV) observed by GOES16 was Background to Moderate, peaking at 657 pppc at 26/0540 UTC. The associated 24-hour fluence was below the Active threshold, but on a recent rising trend. The 26/0000 UTC observation was 8.48e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with an ongoing chance of further isolated M-class flares.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs, with the previous anticipated CME arrival likely having missed, although a very late arrival is not ruled out later day 1

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(26 Sep). Current slightly elevated winds are expected to ease to background before the next enhancement either late day 3 or day 4 (28-29 Sep), from any fast wind onset from CH76/-, although this is low confidence. Mainly Quiet geomagnetic activity expected with Unsettled intervals, but with a chance of Active to G1 Minor Storm day 1 (26 Sep), should any late CME arrival occur, and a chance for a spell of Unsettled to Active spells from any fast wind enhancement late day 3-4 (28-29 Sep).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is forecast to persist at background. High energy electron flux at GOES16 is likely to rising to Moderate to High as solar winds ease, with the associated 24 hour Electron Fluence also rising as a response. This will bring a chance of Active fluence, mainly by day 3 (28 Sep), although confidence remains low, especially with the potential for a further fast wind enhancement late in the period.

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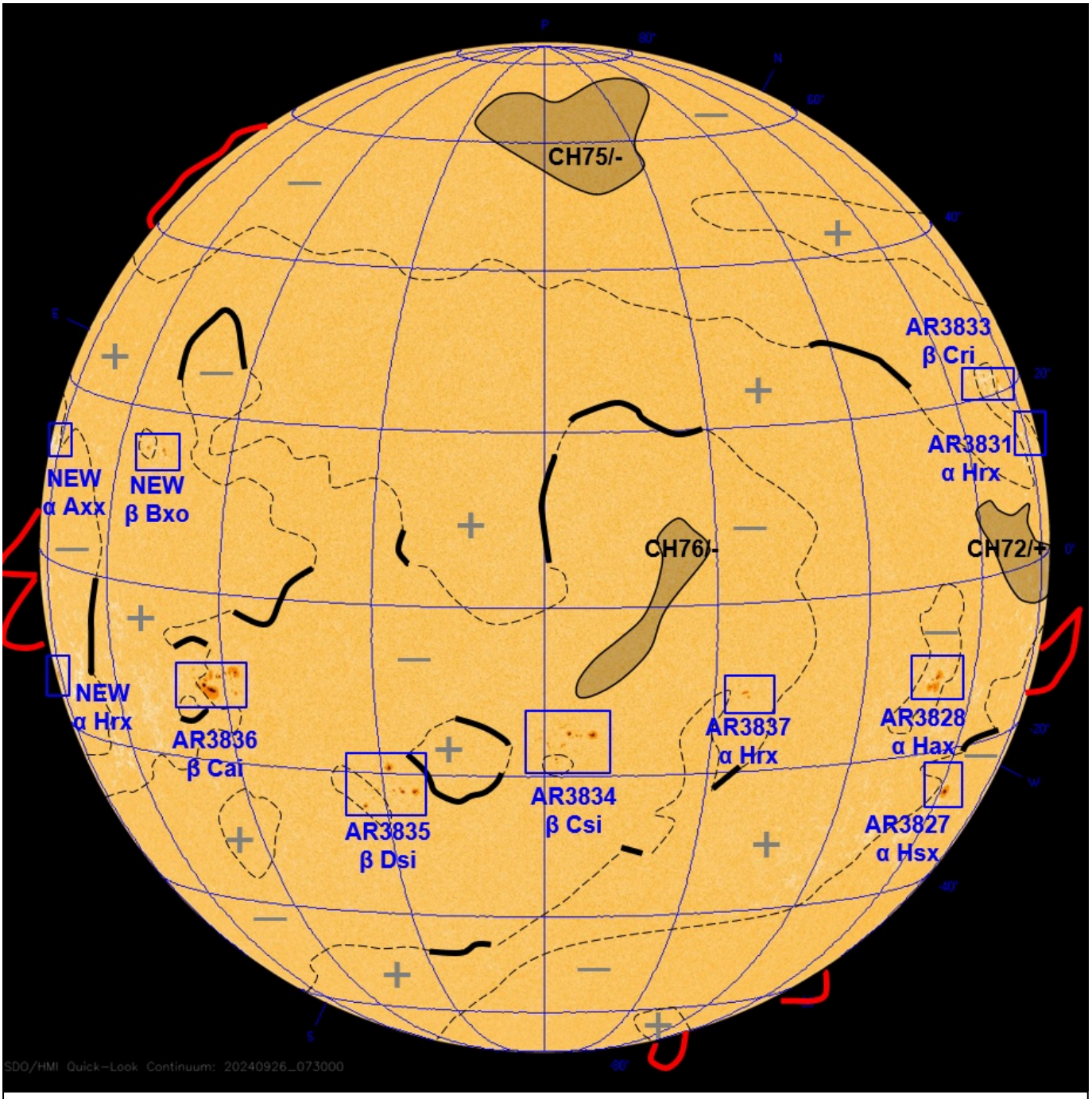
Figure 1: Solar Synoptic Analysis 26/0800 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

The CME from the M3.7 flare off the southeast quadrant has likely either missed, or arrived weakly, absorbed into the overall signal of the fast wind of CH72. However, an ongoing signal in ACE EPAM perhaps suggests a very late arrival is still possible, with a nominal Active to G1 Minor storm risk maintained on day 1 (26 Sep) due to this.

Otherwise slightly elevated solar winds are likely to continue easing to background as the recent fast wind enhancement eases back to more typical slow wind conditions. The next enhancement is expected to be from CH76/-, a narrow coronal hole in the centre disc. As a negative polarity feature, this is unfavoured for a strong connection at Earth, however a fast wind of around 450km/s would see onset on day 3 or more likely day 4 (28-29 Sep).

Aside from any the slight chance of a CME arrival, mainly Quiet conditions are now expected with isolated Unsettled intervals. The onset of any fast wind of CH76 will likely bring a spell of Unsettled to Active, most likely on day 3-4 (Sep 28-29).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
2024-09-23 00:31Z	Partial	Filament	SE	1195 km/s	2024-09-25 12:00Z	Likely missed, but slight chance of weak arrival still to occur on 26 Sep

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Radio Blackouts - X-Ray Flares

Low to Moderate activity is expected, with an ongoing chance of M-class flares. There are eleven sunspot regions currently on the disc, however these are generally small and simple

The largest region is AR3836, however the majority of this region is all one polarity, with only very faint positive polarity spots, however some slight recent growth has occurred. AR3835 in the southeast and AR3834 in the south centre are perhaps also of note, comprising of a number of small spots, but any recent development has remained limited. AR3833 and AR3831 are small regions in the northwest, and soon to rotate off the visible disc. However, two new regions have recently also moved over the eastern limb, but remain difficult to assess. A further small new region has emerged in the northeast.

Bright flux continues to be evident on the east limb, e.g. in SDO aia-94, which may indicate further regions to rotate onto the disc. This is supported by far-side helioseismic products, which indicate a strong region of flux over the east limb, although at this stage it is impossible to tell the complexity of any such spot.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	50	50	50	50
Very Active	R3-R5 (X Class)	No	5	5	5	5

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Figure 2: GOES-16/18 X-ray Flux

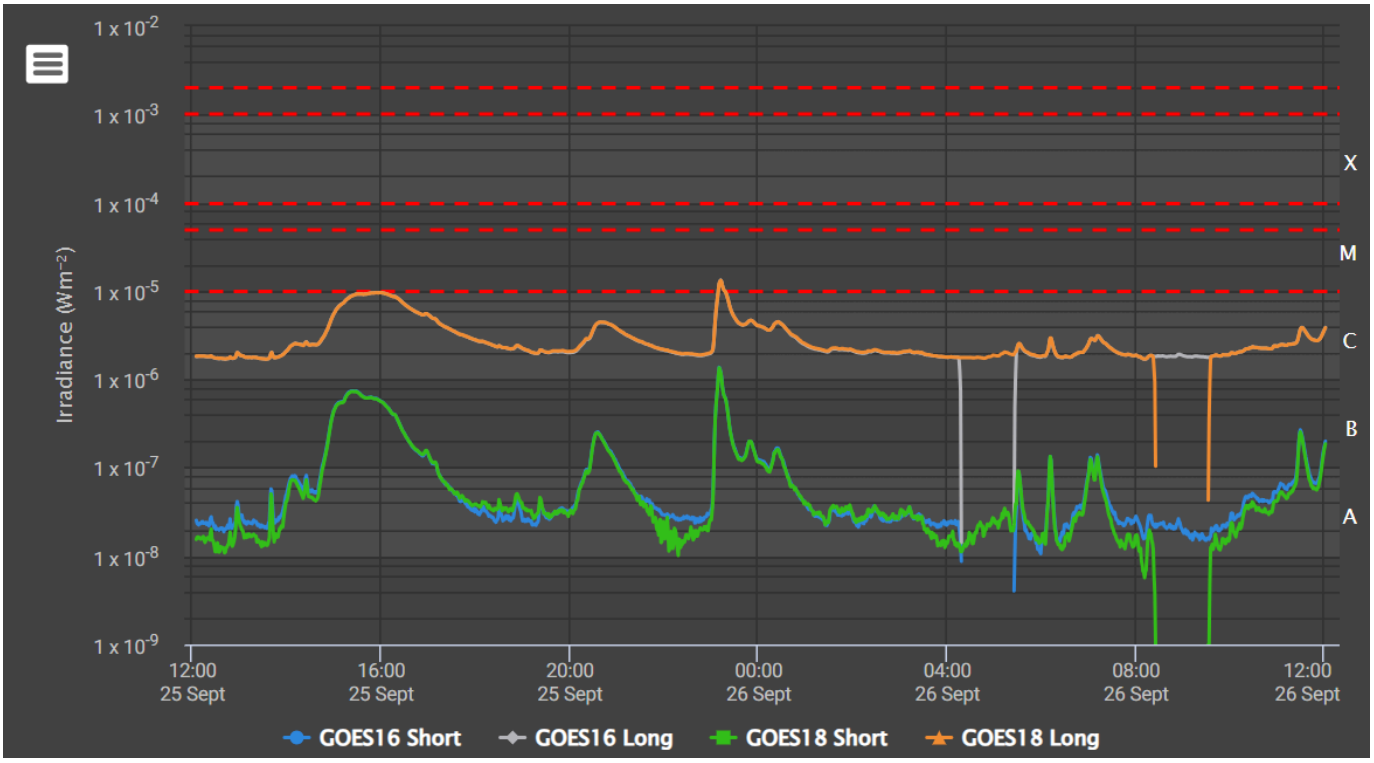
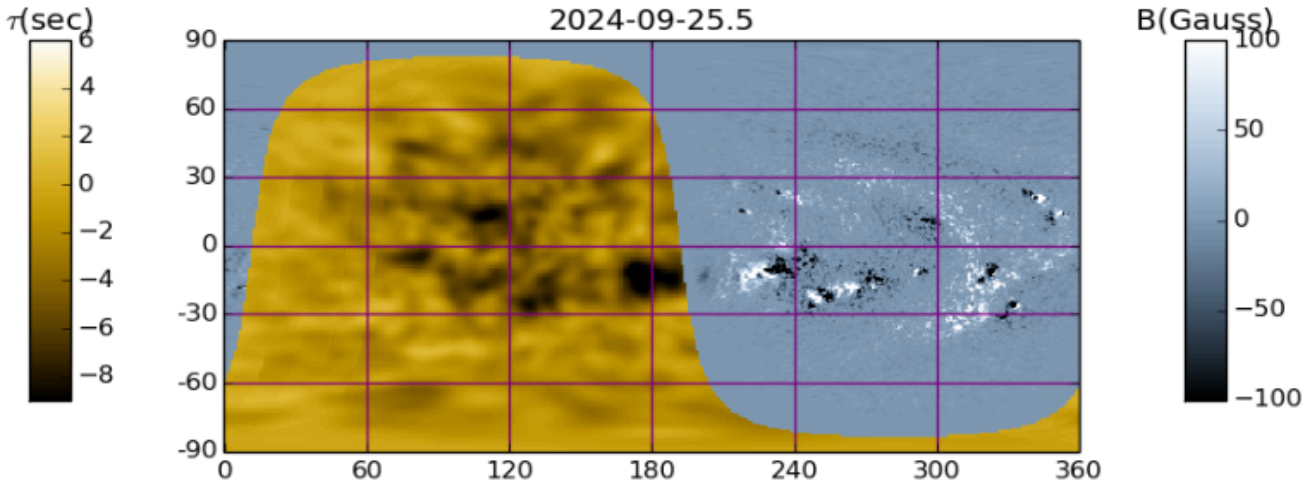


Figure 3: Far-side helioseismic signatures from http://jsoc.stanford.edu/data/farside/ Dark area highlights potential new spot returning.



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Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES18 is forecast to persist at background levels, with only a very slight chance of rising above the S1/Minor Radiation Storm threshold.

The current visible sunspots are small and largely simple providing only modest contributions to flare risk, and any subsequent proton production. However given the number and size of notable filaments currently on the disc, there is also a non-zero, albeit very low chance of observable protons should any significant filament eruption occur.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

GOES-16 high energy electron flux has varied between Background and Moderate. As solar winds ease, there is a chance for the observed electron flux at GEO to rise. This is due to any enhanced flux at lower orbits, after the fast wind enhancement from CH72/+ easing outward. This is likely to bring more persistent periods of Moderate flux, and potentially periods of High flux from days 2 (27 Sep). Any fast wind enhancement from CH76/- also has the potential to supress the observed flux days 3-4 (28-29 Sep), however this is low confidence.

The associated 24 hour fluence is currently below the Active threshold, but is likely to see a rising trend as solar winds ease, with a chance of reaching Active, most likely by day 3 (28 Sep). This is supported by REFM, which also shows a rising trend, although this is currently considered to be underestimating likely values. Confidence is Low however, especially by late day 3-4 due to the potential further fast wind onset.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	30	40	40
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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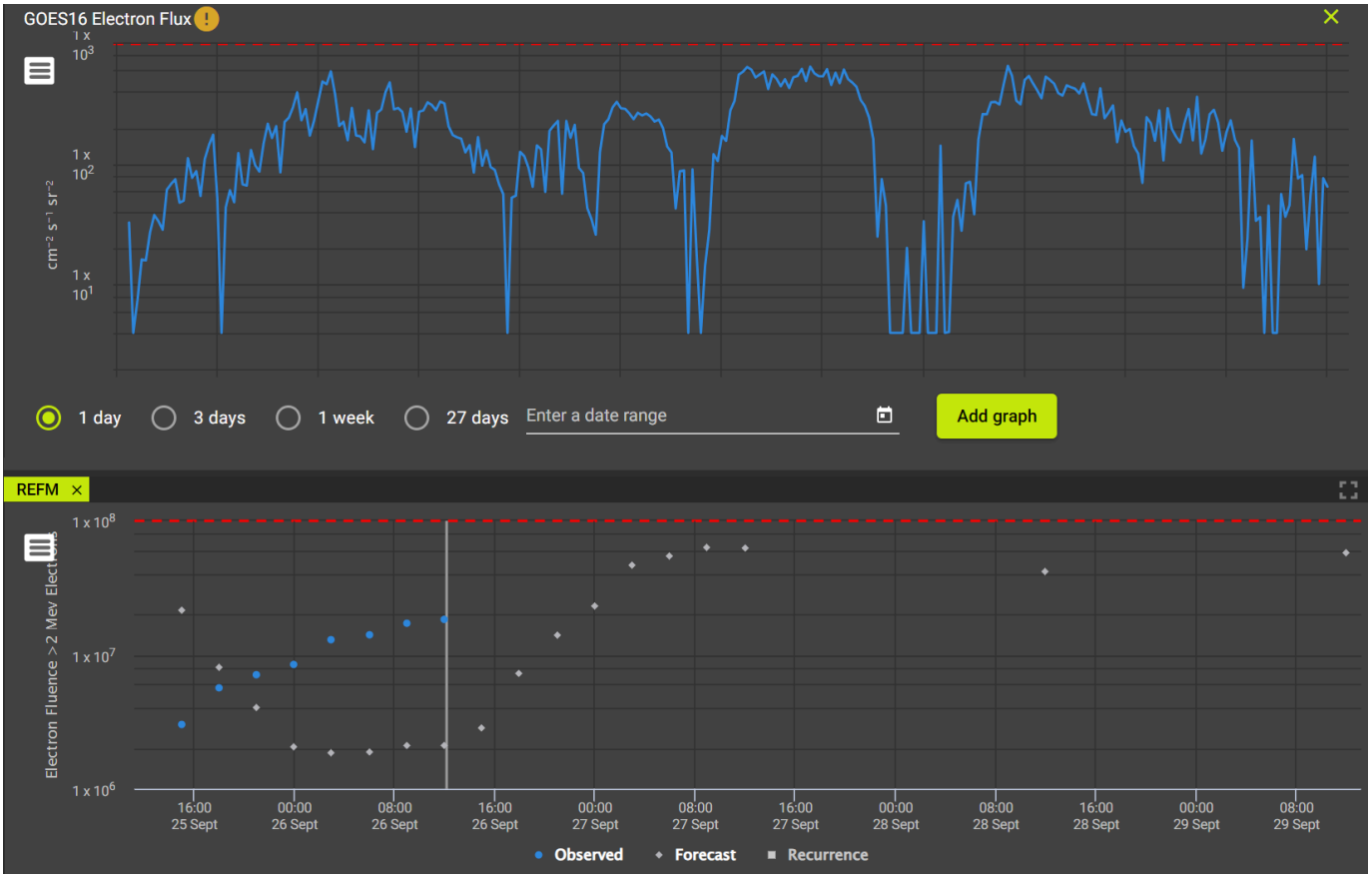
Figure 4: GOES-16 Electon Flux and associated 24hr Fluence with REFM Shows a rising trend, although REFM likely underestimating expected values.



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